the month of May for routes between New York and Washington, New York and Cleveland, Cleveland and Chicago, Chicago and Omaha. In all, 54,693 miles were flown. Two forced landings were made on account of mechanical troubles, fifteen because of running out of oil or gas in combating head winds, four on account of bad weather, and seven because of the lack of familiarity of new pilots with the course. In the eight-month report 75 per cent of the forced landings are attributable to the weather, and for the month of May 68 per cent. While it is true that the actual number of forced landings is small, considering the number of miles flown and the rigorous schedule which is maintained by the mail service, nevertheless, these reports emphasize the dependence of the aviator upon weather conditions.—*C. L. M.*

DAYTIME WIND TURBULENCE IN A MOUNTAIN VALLEY.

By B. M. VARNEY.

[University of California, July 15, 1920.]

SYNOPSIS.

An unusual example of wind turbulence in the daytime air stream in mountain valleys is found near Yosemite Valley, Calif. The stream as it flows east up the valley in the afternoon divides through two branch canyons, the current in the southeasterly branch turning sharply round a steep mountain spur. This spur and the configuration of the canyon walls sets up a rotation of air in the lee of the cliffs about an inclined axis, the lower end of which is at the spur, the upper end about a mile away to the east, the general trend being parallel to the side of the canyon. The path of an air particle near the periphery of this roll was found, by observations on the drift of tissue papers, to be that of a great spiral, the diameter of which seems to vary from nothing at the spur to perhaps 2,000 feet at the east end. Observed variations in the form of the spiral are due to changes in the local winds under the influence of topography.

Paper pie plates do not ordinarily lead to even casual studies of winds in mountain valleys. They are not commonly thought of as anemoscopes. In Yosemite Valley, Calif., in the early afternoon of June 8, 1920, however, a certain pie plate, having presumably functioned in the manner common to pie plates, suddenly and under circumstances unknown to the writer, assumed the role of an anemoscope and led to an hour's most interesting study and to the discovery of a wind phenomenon not hitherto observed by the writer.

Yosemite Valley, trending in a general east-west direction, branches at its upper eastern end into two valleys, Tenaya Canyon toward the east-northeast and the canyon of the Merced River leading by two right-angled turns, first south a half mile and then east a mile up a steepish gradient to Little Yosemite Valley, which penetrates the Sierra Nevadas in a general east-southeast direction. Between the two branches stands a mountain mass of which Half Dome, 4,892 feet above the main valley floor, is the dominating feature. The daytime stream of air up the Yosemite Valley, of course, splits against this mountain mass, the stream into the Little Yosemite being forced through the narrow and crooked canyon of the Merced River. At the second turning (south to east) the stream passes round a sharp and steep spur which stands like a slanting door post in the reentrant angle of the canyon, and past which the wind on clear, warm summer days often whistles with gale force. This sudden turn, together with the configuration of the corner as noted, appears to be responsible for the extraordinary turbulence to be described.

The writer was on a jutting point on the spur some eleven hundred feet above the valley floor, from which point the accompanying eastward-looking sketch was made, when suddenly a paper pie plate came swirling up from below in a vertical suction current in the lee of the spur. In a twinkling the rushing current aloft, turning round the mountain spur, caught the plate and hustled it off upward and eastward. Thus began the flight. It was easily traced, first with the gray cliffs as background and then a clear sky. Presently the plate began to draw away from the cliffs, rose, and describing a gigantic arc toward the middle of the valley, finally got into a downward rush at a speed far too great to be due to the simple action of gravity on the plate in still air. This looked like the end of the flight. When, however, the plate seemed about to be lost in the forest at the bottom, its flight gradually turned into a rush at high speed over the tree tops eastward up the valley, then into an ascent toward the north valley wall, then into another swirl aloft close to the rocks, like the first, another drawing out over the valley, another descent until again it seemed as if the flying plate must "crash," but then another run up the valley as before, turning again into a flight upward along the rock wall and ending out of sight behind a mountain spur nearly a mile away (Mt. Broderick in the sketch).

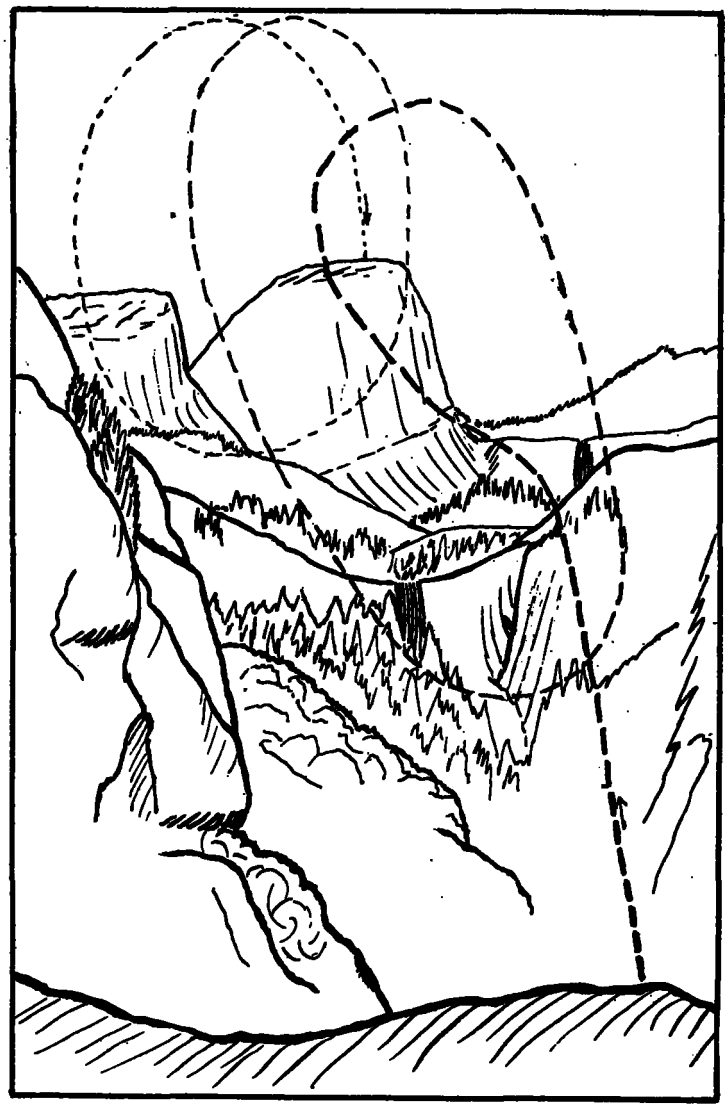

FIG. 1.—Path of paper-flight observed from Sierra Point, Yosemite National Park, early afternoon of June 8, 1920, looking east. North side of canyon of Merced River on left. Vernal Falls in middle distance, ½ mile away. West face of Mount Broderick, left distance, ¼ mile. Nevada Falls (right), 1½ miles. Summit of Liberty Cap, 1½ miles. The top of the first turn in the spiral, estimated to be about 500 feet above point of observation; top of last turn, over Liberty Cap, estimated at about 2,500 to 3,000 feet (the latter estimate being based on the fact that the summit of Liberty Cap is 1,600 feet above Sierra Point, and that the face of the sheer cliff extends about 1,300 feet below the summit). Sketched from a photograph taken by the writer.

The feat was so remarkable that the writer spent the ensuing hour and more in launching broad sheets of waxed tissue paper in an attempt to learn if the huge spiralling current thus discovered were permanent. For the papers, very thin and light, undoubtedly indicated closely the courses of air particles as they varied with the different "flights." More than a dozen flights were made, some of them so long that the papers were followed with some difficulty even with the help of six-power binoculars. Every flight showed more or less strikingly the spiralling path first noted. The number of complete turns made varied from one to three, the time of flight from about five to about eight minutes, the horizontal distance travelled from a few hundred feet to over six thousand. The most remarkable flight, which the accompanying sketch is intended to illustrate, lasted nearly seven minutes, covered the greatest horizontal distance in three rotations along the spiral, and ended, so far as could be seen, more than six thousand feet away with a descent from the blue behind Liberty Cap. The top of this peak is some sixteen hundred feet above the point at which the flight began. There is no question but what the spiralling motion thus observed, and which involves the rotation of a huge mass of air about a more or less horizontal axis, is a persistent phenomenon here on warm afternoons.

The axis of the roll lies roughly parallel to the north wall of the canyon and seems to slope rather sharply upward toward the east. Its diameter increases greatly with increased distance from the corner of the canyon where it begins; for the papers almost without exception flew higher on successive turns, while they reached nearly the valley bottom at each descent. This is due to the fact that the valley wall increases in height from the corner eastward. The roll occupies the north side of the valley only, since in their ascents all the papers passed close to the cliffs, or in other words close to the periphery of the roll, and in their descents never crossed the river to the south side. What the conditions were on the south side was not apparent.

The shapes of the courses of air particles along the spiral may be likened to the varying forms which a watch spring would take if drawn out in a more or less elongated spiral. The exact form of the courses indicated certainly depends on at least three factors: First the speed of the general air current up the canyon; second, the variations in the upward suction effect in the lee of the door-post spur, induced by variations in the strength of the overpassing current of the general stream; and third, the rather active heating of the north rock wall by the sun on clear days, with consequent rise of air. In cross section the spiral seems asymmetrical, the horizontal axis being considerably shorter than the vertical. A part of this is apparent rather than real, due to foreshortening; but not all, for the upward flights often carried the papers so high that they were followed with difficulty, flashing in the sun as they were, even with the aid of the glass, while as before noted they never crossed the stream to the south, which is horizontally less than a thousand feet from the upper cliffs on the north side of the canyon.

There was no observable constancy of relation between the number of rotations about the axis of the spiral and the horizontal distance or the time of flight. Some of the longer distance flights showed the smaller number of rotations, while short-time flights sometimes had the maximum number of rotations.

This vast spiral may presently make interesting flying for some venturesome air man, occupying as it does something less than half the cross section of a narrow canyon, up which sight-seeing and mail service by air to Merced Lake and Hotel may conceivably be put in operation. Flying a few hundred feet north of the Merced River probably would lead to trouble with the strong descending current there observed. By hugging the north wall of the canyon precarious advantage might be taken of the lively ascending current there to make a thousand or more feet of altitude in a few seconds, though the danger of the wing tip next the cliff being caught in more rapidly upward moving air than the other, and of serious consequences when the plane was caught suddenly in the upper current above the cliffs, might be considerable. The safer flying will undoubtedly be done on the south side of the river, or, indeed, well above all the canyons and crags with their turbulent air currents.

Not the least interesting item to the writer in observing the paper flights was the air battles waged by the swallows (?) against these strange invaders of their mountain air lanes. Each paper as it wheeled on its course became the object of violent attack by the excited birds, who continued their darting thrusts until distance left only the flashing papers visible.

A FOG PHENOMENON OF SAN FRANCISCO BAY.

By B. M. VARNEY.

[University of California, July 21, 1920.]

SYNOPSIS.

Occasionally when ocean fog is covering the land and the Golden Gate west of San Francisco Bay, a local fog bank [1] forms along the eastern shore of the bay while the rest of the region remains clear. Conditions of air and water temperature and of topography being seemingly unfavorable to the formation of fog in this zone, it is suggested that the fog may be due to forced rising of the humid westerly wind over convection currents, themselves cloudless, on the plain east of the bay, condensation resulting from this forced rise. This local fog bank disappears in the latter part of the day, due to the breakdown of the convection currents.

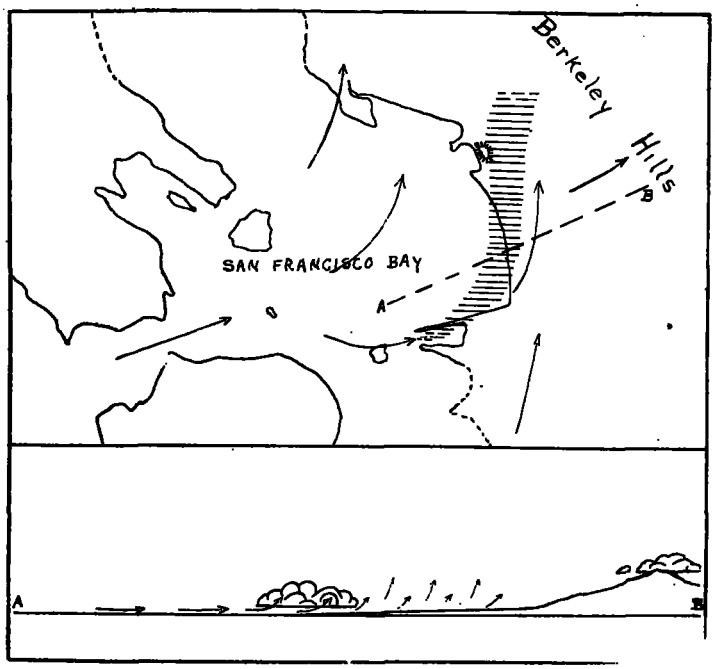

FIG. 1.—Map and cross section illustrating occurrence of fog bank over eastern side of San Francisco Bay and adjacent land. Shaded portion=approximate area of fog; arrow show estimated drift of air currents, from observations of fog and smoke. Vertical scale of section along line AB greatly exaggerated.

[1] This is, technically speaking, a band of strato-cumulus cloud, since it is not in contact with the ground. Such low cloud, forming over the plain and the Berkley Hills to the east, is locally known as "high fog," though it frequently hovers but a few yards from the ground.